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BEHAVIOR ANALYSIS AND DECISION MAKING

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Behavior analysts have developed powerful methodologies to assess central phenomena in areas that have been dominated by cognitive psychologists. Advances in instructional control, stimulus equivalence, choice, rule-governed behavior, matching to sample, and verbal behavior are some of the tools that have been developed in the experimental analysis of behavior. Although the article focuses on the experimental analysis of reasoning, this is but one of the areas in which behavior analysts should have a greater impact on contemporary psychology.

Key words: behavior analysis, decision making, choice, base-rate error, conjunction fallacy, observing behavior, matching to sample

Choice has been widely studied in the behavior-analytic laboratory (e.g., de Villiers, 1977; Herrnstein, 1970; Rachlin, 1989; Williams, 1994), yet there are important cases of nonoptimal human choice and decision making in ordinary situations that have received relatively little attention from behavior analysts. Instead cognitive (and social) psychologists have explored these phenomena and have revealed much about the characteristics of such nonoptimal behavior and about the conditions that generate it. Despite these advances, cognitive accounts are at best incomplete in providing a general framework for these phenomena. Nor do the accounts have much to say about the learning histories that give rise to these phenomena. Behavior analysis, with its emphasis on stimulus control, conditioned reinforcement, and the experimental history of the subject, should be ideally suited to help provide a more general account. This paper reports on the application of behavior-analytic methodology and orientation to some important phenomena in decision making that have perhaps received insufficient attention from behavior analysts.

The approach known as cognitive psychology developed around the notion of human information processing (e.g., Lindsay & Norman, 1972). Although information processing may be addressed in behavioral terms (e.g., by considering stimulus control and sensitivity to reinforcement contingencies), this article focuses on how human decision making is controlled by relevant information about the environment (how current stimuli and learning history combine to determine choice). I attempt to show that humans are rather poor information processors (in terms of being biased and selective) who often make nonoptimal choices, and offer an account as to why this might be so. Specifically, behavior analysts are in a position to go beyond a static descriptive account of decision making by developing an account in terms of the decision maker's learning history and the effect of that history on current stimulus control.

I first review evidence suggesting that we are practical information processors who select good or useful news but avoid bad news. At the same time, we fail to be influenced by stimuli that are not presently useful but that are *potentially* useful. Information we do assimilate tends to be biased and greatly influenced by prior associations and by the context in which the information is provided. This tendency, long known to experimental psychologists (e.g., Carmichael, Hogan, & Walter, 1932), helps to explain some robust and pervasive errors of decision making such as base-rate neglect and the conjunction fallacy. Finally, the article addresses the related and time-honored puzzle of probability matching; that is, in a simple binary choice, human subjects match their response proportions to reinforcement proportions rather than responding optimally (by always choos-

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ing the outcome with the more probable payoff).

INFORMATION AS REINFORCEMENT

Before discussing situations in which humans misuse information, a more fundamental issue should be addressed: Under what conditions will humans elect to expose themselves to information affecting their lives when the information cannot affect the reinforcement schedule in effect? Studies of observing in the behavior-analytic tradition have addressed this very question. Observing responses are those that produce stimuli correlated with schedules of reinforcement but that have no effect on the occurrence of reinforcement (Wyckoff, 1952). In a typical case, two equally probable schedules, differing only in frequency of reinforcement, alternate unpredictably; observing responses produce stimuli correlated with the schedule in effect. For example, a schedule providing reward might alternate with extinction in the presence of a single stimulus; observing responses would produce stimuli that identify the reward and extinction components.

Observing behavior has been investigated extensively, and many reviews have addressed the mechanism by which it is maintained (see reviews by Daly, 1985; Dinsmoor, 1983, 1985; Fantino, 1977). Observing is a robust phenomenon, occurring in many species, and has generally been understood in terms of two rival theories. The conditioned reinforcement hypothesis of observing holds that responding is maintained by stimuli according to their correlation with reinforcement. For example, stimuli that represent a reduction in expected time to reinforcement are predicted to be conditioned reinforcers and accordingly are predicted to maintain observing responses better than stimuli uncorrelated with reinforcers (Case & Fantino, 1981; Case, Fantino, & Wixted, 1985; Dinsmoor, Browne, & Lawrence, 1972; Fantino, 1977). The uncertainty-reduction hypothesis, on the other hand, proposes that informativeness per se is reinforcing because of the presumed unconditioned aversiveness of uncertainty (e.g., Berlyne, 1960). Although many findings are consistent with both, the critical test for distinguishing these views is whether or not a stimulus associated with bad news (an S−) is reinforcing. The preponderance of evidence shows that it is not (e.g., see Case, Ploog, & Fantino, 1990; Dinsmoor, 1983; Fantino & Case, 1983; exceptions are noted shortly).

A critical problem in assessing the importance of the behavioral principles that have evolved from laboratory studies concerns the extent to which these principles have generality in more natural settings. It would be a hollow accomplishment for behavior analysts if their impressive prediction and control of behavior in the laboratory did not generalize to well-controlled settings outside the laboratory. It is hard to think of more natural behavior in the college student than interaction with a computer. Case et al. (1990) developed a modified version of the computer game *Star Trek* to assess college students' preferences for different types of information in a study of observing behavior. In the prior work on observing, the reinforcers used were points backed with events that may be viewed as extrinsic to the experimental task (e.g., money), whereas in Case et al.'s study, reinforcers were an integral part of a task designed to be a realistic and entertaining simulation of naturally occurring behavior. Again, the results of Case et al. supported the conditioned reinforcement hypothesis: In several variations of the basic game, an S−, or bad news, did not maintain observing as well as an S+, or good news, did. In addition, in other conditions for the same subjects, observing responses were not maintained better by bad news than by an uninformative stimulus. More observing tended to be maintained by an S− when its information could be (and was) used to advantage with respect to other types of reinforcement in the situation than when the information could not be so used. For example, when subjects received the "bad news" that no Klingons were available for destruction, they still preferred that news to unreliable news (i.e., stimuli uncorrelated with the events) if they could use the interval to refuel. Otherwise, the S− did not maintain observing. It is apparent, then, that even in more naturalistic situations information or uncertainty reduction does not generally maintain observing unless it provides positive conditioned reinforcement by virtue of its discriminative function (as in the refueling example). Even in well-controlled laboratory studies of observing, the potential exists for this type of conditioned reinforcement. For example, a putative S− may signal the opportunity to rest, to self-groom, or to engage in other activities that are constrained at other times in the experiment. Perhaps such unintended sources of reinforcement may be implicated in results suggesting that an S− may maintain observing (e.g., those of Lieberman, Cathro, Nichol, & Watson, 1997, and of Perone & Kaminski, 1992). In any event these latter studies demonstrate that the conditions under which an S− will maintain observing cannot yet be specified as neatly as the earlier results of Case et al. (1985, 1990) and Fantino and Case (1983) suggested.

It also appears that in most natural settings ostensible S−s provide a wealth of potential conditioned reinforcers. Indeed, it is very difficult to develop a hypothetical example of a piece of information in our lives that does not have some potential positive discriminative function. The extent to which humans acquire information that is both aversive and potentially useful is perhaps the domain of social psychologists (e.g., Leventhal & Hirschman, 1982). For example, patients have admitted taking longer to seek help after discovering a symptom if they imagined possible severe consequences of their illness (Safer, Tharps, Jackson, & Leventhal, 1979). However, Fantino, Case, Stolarz-Fantino, Spechko, and McCutchan (1993) found that most of their gay volunteers desired human immunodeficiency virus (HIV) antibody test results and indicated that receiving them would affect their subsequent behavior. Clearly a complex set of contingencies operates in the natural world when decisions must be made involving aversive consequences. The research from several behavior-analysis laboratories cited above suggests that special care must be taken if information that is critical to arrive at an optimal decision is not to be avoided.

BASE-RATE NEGLECT

Avoidance of even benignly useful information lies at the core of the base-rate error, in which, when predicting an event, educated subjects neglect the molar frequencies of various possibilities and overemphasize case-specific information (Kahneman & Tversky, 1973). For example, Tversky and Kahneman (1982) presented the following problem (for which we have developed a behavioral analogue):

> A cab was involved in a hit-and-run accident at night. Two cab companies, the Green and the Blue, operate in the city. You are given the following data: a) 85% of the cabs in the city are Green and 15% are Blue; and b) a witness identified the cab as Blue. The court tested the reliability of the witness under the same circumstances that existed on the night of the accident and concluded that the witness correctly identified each one of the two colors 80% of the time and failed 20% of the time. What is the probability that the cab involved in the accident was blue rather than green? (pp. 156–157)

In this problem, the *molar* probability is that 85% of all cabs in the city are green and 15% are blue. The *case cue* is the witness's claim (which is 80% reliable) that the cab is blue. On average, subjects report that the probability that the cab is blue is 80%, which corresponds to the witness's accuracy; whereas simple mathematics shows that there is actually only a 41% chance that the cab is really blue. Despite many demonstrations of the base-rate error with paper-and-pencil tasks, it remained to be seen whether the error would occur in a more behavioral task with repeated trials and reinforcement made contingent upon correct responding (Goodie & Fantino, 1995; Stolarz-Fantino & Fantino, 1990). The base-rate problem may be seen as one of multiple stimulus control, in this instance control by the base rates and control by the case cue. In the standard paper-and-pencil tasks subjects' choices are controlled predominantly by the case cues and hardly at all by the base rates, whereas the equivalent weighting of both is required for optimal responding. An ideal behavioral analogue of the base-rate problem, which readily permits independent manipulation of the two potential sources of stimulus control, repeated trials, and reinforcement contingent on correct responding, appeared to be matching to sample, used extensively in human behavior-analytic laboratories. Thus, Goodie and Fantino (1995) used a matching-to-sample procedure in which a sample stimulus (either a blue or green light) is followed by two comparison stimuli (blue *and* green lights). On each trial, subjects were asked to predict whether the ''correct'' answer on that trial was green or blue. Subjects did this by choosing either the blue or green comparison stimulus when both were presented. The correct answer was green 67% of the time; 33% of the time blue was correct. In one condition these percentages were unaffected by the preceding sample. In other words, whether the sample was green or blue, the likelihood that the green choice was correct was two thirds. Samples in this condition were therefore totally uninformative (50% cue accuracy condition). In another condition the sample was somewhat predictive of the correct choice (67% cue accuracy condition). In each condition we measured how often subjects selected green and blue. In particular, we measured how often subjects matched the sample (i.e., guessing green if the green sample had appeared, or guessing blue if the blue sample had appeared). Roughly equal matching to the blue and green samples would indicate that subjects treated both samples alike despite a two-to-one difference in their base rates (67% to 33%). If subjects chose optimally, they should always select green (and never blue) when the sample is uninformative (50% cue accuracy condition). In terms of matching choice of the comparison stimuli to the sample, they should always match green (100%) and never match blue (0%). On the other hand, if the base rates are neglected the difference in matching the two samples should be far less dramatic. Such a failure to distinguish between sample types is a hallmark of the base-rate error. In fact, subjects matched blue more than half the time, and the average difference between matching green and blue was only 7%.

These results, replicated with monetary rewards and occurring over hundreds of repeated trials, suggest that the base-rate error indicates fundamental insensitivity to unconditional probabilities and not merely verbal aspects of the problem. But what is there about the base-rate problem that discourages sensitivity to unconditioned probabilities? Surely we are capable of sensitivity to unconditioned probabilities. Moreover, Hartl and Fantino (1996) have used a comparable delayed matching-to-sample procedure with pigeons and found no evidence of a base-rate error. Instead, the pigeons selected optimally in terms of maximizing rate of reinforcement. What might account for this different susceptibility to the base-rate error in humans and pigeons? Stolarz-Fantino and Fantino (1995) have suggested that humans have acquired certain repertoires for dealing with matching problems that they misapply in our base-rate analogue. The pigeon, unencumbered by a history of matching problems, readily acquires an optimal response pattern. In particular, humans have been exposed since early childhood to innumerable matching tasks (perhaps beginning with block play and picture books). Thus, they may have a strong tendency to match the sample, a tendency not easily overridden. Indeed, to the extent that we have acquired matching repertoires on the basis of rules imparted by parents, siblings, and teachers, we may display the kind of insensitivity to changes in contingencies that sometimes characterizes rule-governed behavior (e.g., Catania, 1992).

Goodie and Fantino (1996) explored in three additional experiments the possibility that the base-rate error is a learned phenomenon. The first two differed from their previous experiments only in the nature of the stimuli used as predictive cues. The comparison stimuli, as before, were always blue and green lights. Experiment 1 used arbitrary symbols as cues. If the base-rate error results from subjects' histories of matching items that are similar to one another, then this should reduce the base-rate error. The green and blue cues (i.e., the samples) were replaced by vertical and horizontal lines, respectively, and the base-rate error disappeared entirely. In Experiment 2, they again used symbolic cues, but now they were not arbitrary. They used the words *green* and *blue* as they had once used the colors green and blue. Given the presumed history of matching the word *green* to green things and *blue* to blue things, they predicted that the base-rate error would reappear; and in fact it did, as strongly as with identical cues. The results of these first two experiments are shown in Figure 1, which plots the percentage of trials on which blue was chosen after a horizontal (left) or blue (right) sample and the percentage of trials on which green was chosen after a vertical (left) or green (right) cue. In a third experiment, Goodie and Fantino gave

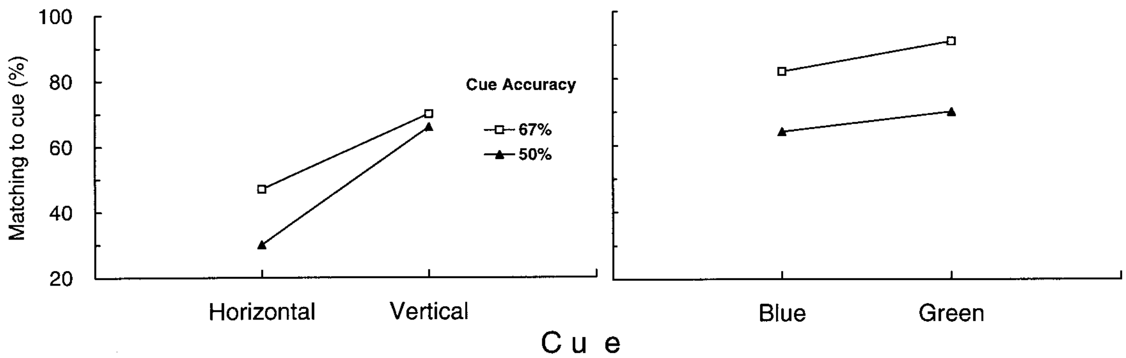

Fig. 1. Data from Experiments 1 and 2 of Goodie and Fantino (1996). The left panel shows data from their first experiment in which there was an arbitrary relation between the cues (white horizontal or vertical lines) and the items being chosen (blue and green particles); base-rate neglect was minimal, as shown by the sharp slope of the lines. The right panel shows data from their second experiment in which there was an acquired relation between the cues (the words *blue* and *green*) and the items being chosen (blue and green particles); base-rate neglect was robust, as shown by the relatively flat slope of the lines (adapted from Goodie & Fantino, 1996).

their subjects a particular learning history (instead of presuming it as in Experiment 2): perfect correspondence between a vertical cue and green being correct and between a horizontal cue and blue being correct. The base-rate error occurred for subjects with this prior training but not for control subjects without this training.

Collectively these experiments demonstrate a base-rate error dependent upon learned probabilistic relationships. Preexisting association between cue and outcome can prevent, or at least retard, learning from experience. The pigeon, unfettered by these preexisting associations, profits more readily from comparable experience (although it should be possible, with sufficient training, to produce base-rate neglect in the pigeon as well). These findings, and related ones from the extensive literature on blocking (e.g., Rescorla, 1988), set constraints on learning that have both practical and theoretical implications.

THE CONJUNCTION FALLACY

Nonoptimal behavior is, of course, not restricted to the base-rate error. An additional classic example is the conjunction fallacy. Subjects demonstrating the conjunction fallacy report that the conjunction of two events is more rather than less likely to occur than one of the events alone (Fantino, Kulik, Stolarz-Fantino, & Wright, 1997; Tversky & Kahneman, 1982). Stolarz-Fantino, Fantino, and Kulik (1996) administered a standard conjunction problem to students at their institution (University of California, San Diego [UCSD]) who were just completing a course in logic. They were asked to read a statement about "Ralph" in which he was described as "not especially creative" and "somewhat compulsive and dull." They were then to rate the likelihood of simple statements, including "Ralph is a building inspector," and "Ralph plays in a heavy-metal band for a hobby," as well as the conjunction "Ralph is a building inspector who plays in a heavy-metal band for a hobby." Their logic professor, a celebrated philosopher, introduced the task as one involving reasoning. Despite this context, 43% of the students committed the conjunction fallacy. Comparably fallacious reasoning was observed by Arkes and Blumer (1985), who found that economics students enrolled in a course covering the sunk cost effect (an example of irrational economic behavior) were just as likely to display the effect as students who were not enrolled in the course. The robustness of the conjunction fallacy among educated, even academically elite, subjects raises the more general issue of how humans react to compound stimuli such as the conjunctive statements of the conjunction problem. In the standard problem, subjects are given a framing description that is thought to bias them into finding the conjunction more representative or more likely than one of the component statements. Thus, if Ralph is described as "not especially creative" and "somewhat compulsive and dull," the conjunction "Ralph is a building inspector who plays in a heavy metal band for a hobby" is rated as more likely than the simple statement "Ralph plays in a heavy metal band for a hobby." But Stolarz-Fantino et al. (1996) also assessed the likelihood of the conjunction fallacy in the *absence* of a framing description and found that over 40% of their subjects (their Experiments 1 and 4) still displayed the fallacy. For example, in their Experiment 4, they assessed the occurrence of the fallacy in a between-subjects design with and without a descriptive (or "biasing") frame. These subjects saw no other questions and had not participated in any of the prior work. Subjects in the nonframe condition were given only the two sentences: "Ralph is 34 years old. You know nothing else about him." Of these subjects, 41% displayed the conjunction fallacy. Although subjects in the frame condition were significantly more likely to display the fallacy (78%), high incidence of the fallacy in the absence of the frame suggests a tendency to overestimate the likelihood of compound or conjunctive events that cannot be reduced entirely to their representativeness.

Fantino and Savastano (1996) took a more behavioral approach to the problem of how humans react to novel compound stimuli. They studied compounds that combined stimuli associated with high and low probabilities of reinforcement. Again this may be viewed as a case of multiple stimulus control, and there is a relation to the conjunctive statements of the conjunction fallacy problem, which typically combine high-likelihood and low-likelihood events. When UCSD students were exposed to such compound stimuli, they usually behaved in a way that implied summation: more responding to the compound than to either of the component stimuli. In particular, subjects learned to discriminate color stimuli that correlated with varying probabilities of reinforcement. Reinforcement consisted of points backed by money. For all subjects, two colors signaled a .80 reinforcement probability, and two others signaled a .20 probability. In training, untrained subjects were exposed only to these four stimuli. For compound trained subjects, a fifth stimulus was a compound comprised of a high-probability color and a low-probability color, which was correlated with a .10 reinforcement probability. During testing, interspersed probe trials required subjects to choose between two alternatives: a novel compound stimulus and either one of its constituent stimuli. Untrained subjects preferred the compound over either individual stimulus, thus showing response summation. Thus, subjects tend to respond more to compounds than to components, a tendency that may help to account for the conjunction fallacy. Furthermore, Fantino and Savastano also found that their trained subjects (i.e., those given training with a single compound that was associated with a lower rate of reinforcement than either of the individual component stimuli) no longer responded to future novel compounds more than to the component stimuli (see Figure 2). In other words, after experiencing a single exemplar compound associated with a low rate of reinforcement (.10), they no longer displayed summation to novel compounds. Future research should address the question of whether the tendency to display summation is already found in children, because this would help to address the question of the provenance of this behavioral tendency to summate.

PROBABILITY MATCHING

In the discussion of base-rate neglect, I pointed out that the neglect may be banished by using stimuli not already associated with a history of matching. When preexisting associations between cue and outcome are avoided, so is base-rate neglect. What I neglected to say is that even when base-rate neglect is eliminated, human subjects do not behave optimally. Instead they match the proportion of their choices to the probability of reinforcement associated with each alternative. This outcome is termed *probability matching* or *probability learning* and has been known and studied for some time (e.g., Estes & Straughan, 1954; Fantino, 1997[1]; Humphreys, 1939; Myers, 1976). In terms of the matching-to-sample procedure used in studies reviewed earlier (e.g., Fantino & Savastano, 1996;

[1] Fantino, E. (1997, May). *The role of experience in human choice.* Paper presented at the meeting of the Association for Behavior Analysis, Chicago.

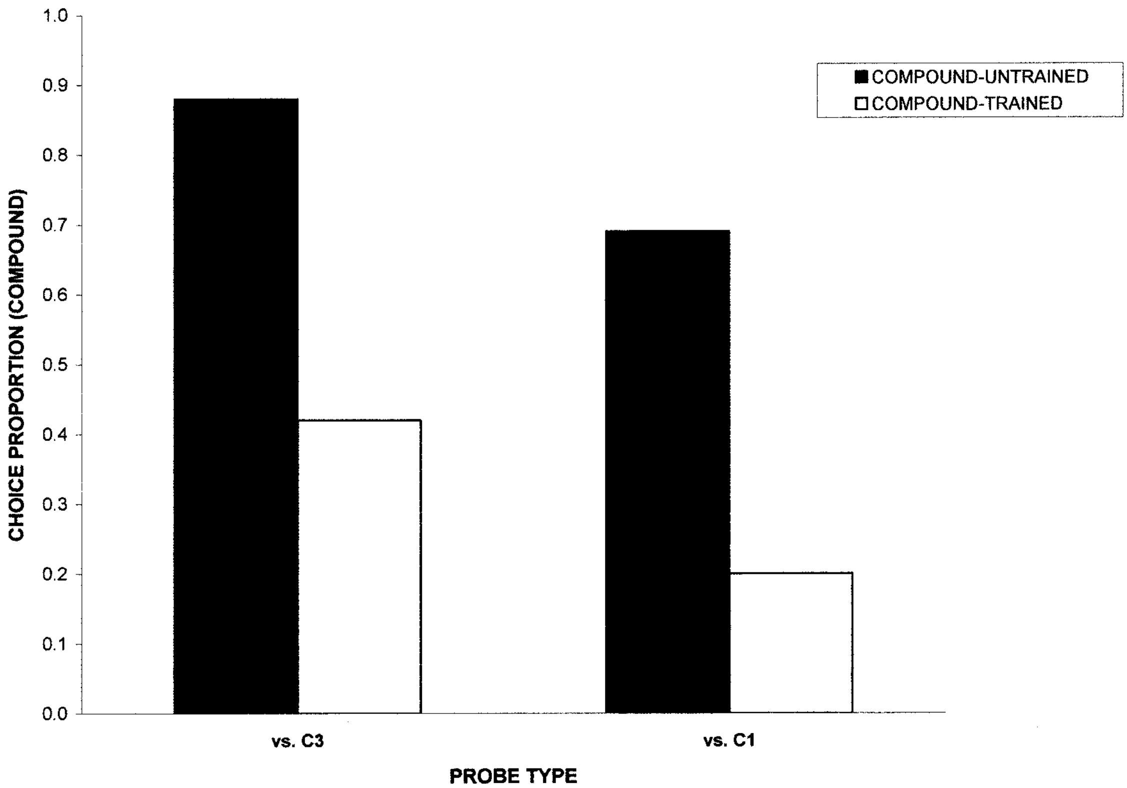

Fig. 2. Mean choice proportions during probe testing for each group of subjects in Fantino and Savastano (1996). Preference is calculated for the novel compound, which consisted of one stimulus correlated with a high probability of reinforcement and one correlated with a low probability of reinforcement. The other alternative in each type of probe trial was C_3, a low-probability stimulus, and C_1, a high-probability stimulus. Whereas untrained subjects tended to choose the novel compound, subjects trained with a single compound associated with a lower rate of reinforcement than either of the individual component stimuli tended not to do so (adapted from Fantino & Savastano, 1996).

Goodie & Fantino, 1995, 1996), one can consider the standard probability learning paradigm as matching to sample without a sample. In other words, subjects are presented with repeated (and identical) binary choices, each associated with a consistent payoff likelihood. For example, assume that choice of the green stimulus provided reinforcement in 67% of the trials, and choice of blue provided reinforcement on the other 33% of trials. If subjects responded optimally they should always select green; choices would then be reinforced in two thirds of the trials. Subjects instead chose green about two thirds of the time (hence the term probability matching) and blue about one third of the time. This strategy permits choices to be reinforced on only 5/9 (or 56%) of trials [because $(2/3 \cdot 2/3) + (1/3 \cdot 1/3) = 5/9$]. This nonoptimal strategy has been shown in a score of experiments (reviewed by Myers, 1976) to persist over even hundreds of trials.

This behavior is perplexing given that nonhumans are quite adept at optimal behavior in this situation (for an extensive treatment, see Sutherland & Macintosh, 1971, especially pp. 451–456). Mackintosh (1969), for example, conducted an experiment on spatial position and visual brightness probability learning in both chicks and rats. Within 100 trials, subjects in three of the four conditions were choosing the higher payoff outcome well above matching levels. Sutherland and Macintosh also report unpublished data of Mackintosh and Little that demonstrated over 90% choice of the higher payoff outcome in pigeons responding to a red-green discrimination in which the payoffs were 70% and 30% (see also Shimp, 1966). Behavior analysts have devoted considerable effort to the related question of matching versus maximizing in a free-operant choice (e.g., with concurrent schedules, as in Herrnstein, 1970; Rachlin, Green, & Tormey, 1988; Silberberg, Hamilton, Ziriax, & Casey, 1978), a question recently reviewed by Williams (1994). Behavior analysts have given relatively little attention to the corresponding issue in probability matching experiments. Do humans match because matching is somehow fundamental in the sense, to use Williams' words, "that it represents the choice rule by which behavior is allocated to response alternatives of different strengths" (Williams, 1994, p. 101)? As Williams goes on to note, the question remains unresolved in the area of free-operant choice. We can add that although the question is also unresolved (and almost unaddressed) in the area of probability matching, the notion of a fundamental choice rule does not appear to be a highly plausible account of such matching. If it were, why would nonhumans routinely maximize in corresponding situations (e.g., Hartl & Fantino, 1996; Sutherland & Macintosh, 1971)? I suspect that, as in the case of base-rate neglect, past experience biases results in favor of matching and the nature of the instructions and demand characteristics of the task are critical. For example, the instructions typically specify or imply that subjects should maximize the number of payoffs earned. Responding exclusively to the higher payoff outcome may be inconsistent with a lifetime's experience of solving elaborate puzzles and exposure to complex sequences in the environment and in educational testing. Certainly human subjects often respond in overly complex ways to relatively simple tasks (e.g., Catania & Cutts, 1963). It is possible that if subjects were told that no higher payoff than 67% were attainable, they would then maximize. In any event, the absence of sample stimuli in probability matching experiments does not necessarily simplify the situation when compared to the base-rate experiments reviewed earlier. Instead of directing their attention to the sample (the source of much of base-rate neglect), subjects may be influenced by sources of control embedded in their rich histories of decision making and problem solving. By varying the nature of the instructions and reinforcers in the task it may be possible to better clarify the variables that control nonoptimal responding in probability matching. A concerted behavioral attack on the problem of probability matching seems long overdue.

CONCLUSION

In this paper I have stressed phenomena in decision making. Similar issues could be raised concerning other important phenomena, study of which has also been more closely identified with cognitive psychology than with behavior analysis. Again, however, behavior analysts may be in a unique position to appreciate these phenomena. Many areas that behavior analysts appear willing to concede to cognitive psychologists are areas to which behavior analysts have in fact made and should be making contributions (e.g., see Donahoe & Palmer, 1994; Shull, 1995). That significant contributions have already been made is well documented. A rich literature has developed the relation between the generalized matching law and signal-detection theory (e.g., Davison & Tustin, 1978) and the application of principles of discrimination (e.g., White, 1985) and conditioned reinforcement (e.g., Wixted, 1989) to remembering. For example, Davison and McCarthy (1988) have shown how signal detection may be viewed as matching and have developed matching models for both standard discrete-trials and free-operant detection procedures. Decision making, problem solving, and reasoning are just three additional examples of areas for which behavior analysts have much to offer and successful application of behavior analysis may enhance its visibility and impact. Behavior analysts have also made strides in the important area of verbal behavior, with major theoretical contributions (e.g., Horne & Lowe, 1996; Skinner, 1957; Sundberg, 1996), empirical advances (such as Lamarre & Holland, 1985; Lee, 1981; Lee & Pegler, 1982; Moerk, 1990), and extensive research on stimulus equivalence (e.g., Sidman, 1994). More often than not, however, these contributions have been addressed to the behavioral community and have not had the impact they deserve among psychologists outside this community. Here and elsewhere, behavior analysts have developed powerful methodologies to assess phenomena in areas of central interest to psychologists, areas that have been harvested by cognitive psychologists. Advances in instructional control, stimulus equivalence, observing behavior, matching to sample, choice, and the theoretical and empirical distinctions between rule-governed and contingency-governed behavior, and advances in other areas as well, supply important tools that could be brought to bear on behalf of a ''behavioral cognitive revolution'' that might help to enhance the impact of behavior analysis on contemporary psychology.

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